

Cyanotoxins in the tidewaters of Maryland's Chesapeake Bay: The Maryland Experience.

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Introduction

Cyanobacteria blooms were noted in the Potomac River and the upper Chesapeake Bay during the 1950s and 1960s coincident with the invasion of water milfoil. Since 1985, cyanobacteria blooms have been documented in the tidal tributaries of Chesapeake Bay almost annually during summer months by the Maryland Department of Natural Resources (MDNR) long-term comprehensive water quality monitoring program. During September 2000, an extensive late summer bloom of *Microcystis* on the Sassafras River, however, was among the first blooms tested for cyanotoxins in Maryland and results were positive for elevated concentrations of microcystin. The microcystin levels ($591.4\text{--}1041\text{ }\mu\text{g}\cdot\text{g}^{-1}$ dry wt) led to the Kent County Health Department closing a public beach in the bloom area for the remainder of the year, the first beach closure in the history of the state due to detected levels of cyanotoxins.

Hypotheses

We hypothesized that elevated cyanobacterial toxin levels were common features of the annual blooms in the tidal tributaries and multiple toxins would be present. Such findings of an increased diversity of toxic HABs and CyanoHABs would represent expanded management concerns regarding human water-related activities and living resources effects for the Bay.

Methods

From 2002 to 2004, MDNR conducted cyanotoxin surveys working with Dr. Wayne Carmichael (Wright State University, Dayton, OH) and Dr. Greg Boyer (State University of New York College of Environmental Science and Forestry, Syracuse, NY). We examined water samples from tidal regions of the Chesapeake Bay with elevated concentrations ($>10,000$ cells/ml) of cyanobacteria.

Results

Microcystin, anatoxin-a and saxitoxin were detected from tributaries throughout Maryland tidewaters at wet weight concentrations of $0.34\text{--}657.9\text{ }\mu\text{g}\cdot\text{L}^{-1}$ ($n=40$), $0.009\text{--}3\text{ }\mu\text{g}\cdot\text{L}^{-1}$ ($n=6$) and $0.003\text{ }\mu\text{g}\cdot\text{L}^{-1}$ ($n=1$), respectively. Mean and median concentration were $35.24\text{ }\mu\text{g}\cdot\text{L}^{-1}$ and $5.04\text{ }\mu\text{g}\cdot\text{L}^{-1}$ for microcystin and $0.54\text{ }\mu\text{g}\cdot\text{L}^{-1}$ and $0.05\text{ }\mu\text{g}\cdot\text{L}^{-1}$ for Anatoxin-a. In 100% of *Microcystis* bloom samples tested (concentrations $> 10,000\text{ cells}\cdot\text{ml}^{-1}$) there were detections of microcystin. Anatoxin-a and saxitoxin testing has been uncommon.

Conclusions

- 1) Microcystin concentrations exceeded the WHO drinking water standard of $1\text{ }\mu\text{g}\cdot\text{L}^{-1}$ with 85% of test samples. Anatoxin-a and saxitoxin have also been detected in the open waters of the tidal tributaries of the Chesapeake Bay system.
- 2) The findings increase the range of habitats where potential human health and living resource threats due to aquatic born toxins must be considered by management agencies in Maryland.
- 3) County health departments again closed beaches in 2003 and 2004 in response to recommendations from Maryland's Interagency Harmful Algae Task Force regarding the detected levels of cyanotoxins. State resource agency efforts to alert the public regarding timing and location of bloom waters as well as potential risks to human health, pets and livestock included 1) HAB webnews articles on the State resource agency websites 2) State Press Releases linked with MDNRs "Eyes on the Bay" water quality monitoring website, and 3) print, radio and TV news coverage of the issues.